What is claimed is:

1. An MIMO communication system comprising a transmitter with #1 to #N (N is an integer equal to or greater than 2) antennas and a receiver with #1 to #L (L is an integer equal to or greater than 2) antennas, in which

said transmitter comprises:

a transmission signal generator for generating a transmission signal;

a signal dividing unit for dividing the transmission signal into #1 to #K (K is an integer equal to or less than smaller one of N or L) signal streams according to transmission weights derived from feedback information informed from the receiver through a feedback path;

a signal modulator for modulating the #1 to #K signal streams, respectively; and

a stream processor for dividing respective #1 to #K modulated signal streams into #1 to #N substreams and multiplying the #1 to #N substreams by the #1 to #N transmission weights, respectively; and

said receiver comprising:

a channel state estimating means for estimating state of each communication channel from received signals received by the #1 to #L antennas to output information of channel state;

a feedback signal generating means for generating feedback information according to the information of channel state;

a feedback-delay compensating means for processing the feedback information in order to

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compensate feedback-delay of the feedback path;

a proper reception weight generating means for generating proper reception weights by using the information of channel state and processed feedback information from the feedback-delay compensating means;

a reception weight multiplier for multiplying the received #1 to #L substreams of respective #1 to #K signal streams by the proper #1 to #L reception weights, respectively;

a demodulator for composing the #1 to #L weighted substreams to obtain respective composed #1 to #K signal streams and demodulating the composed #1 to #K signal streams, respectively; and

a signal combining unit corresponding to the signal dividing unit of the transmitter for combining the demodulated K signal streams from the demodulator to reproduce the original transmission signal.

2. A receiver having #1 to #L (L is an integer equal to or greater than 2) antennas for an MIMO communication system comprising:

a channel state estimating means for estimating state of each communication channel from received signals received by the #1 to #L antennas to output information of channel state;

a feedback signal generating means for generating feedback information according to the information of channel state;

a feedback-delay compensating means for processing the feedback information in order to compensate feedback-delay of a feedback path;

a proper reception weight generating means for

generating proper reception weights by using the information of channel state and processed feedback information from the feedback-delay compensating means;

a reception weight multiplier for multiplying the received #1 to #L substreams of respective #1 to #K signal streams by the proper #1 to #L reception weights, respectively;

a demodulator for composing the #1 to #L weighted substreams to obtain respective composed #1 to #K signal streams and demodulating the composed #1 to #K signal streams, respectively; and

a signal combining unit for combining the demodulated K signal streams from the demodulator to reproduce an original transmission signal.

3. A receiver according to claim 2, in which the channel state estimating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting information of channel estimation as the information of channel state;

the feedback signal generating means comprises:

a transmission weight generator for generating K*N transmission weights based on the information of channel estimation from the channel state information unit and sending the transmission weights as the feedback information to a transmitter through the feedback path;

the feedback-delay compensating means comprises:

a transmission weight accumulation unit for accumulating the transmission weights for a predetermined interval and outputting the accumulated transmission

weights as the processed feedback information; and

the proper reception weight generating means comprises:

a receiving weight generating unit for generating K*L proper reception weights by using the information of channel state and processed feedback information.

4. A receiver according to claim 2, in which the channel state estimating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting information of channel estimation; and

a channel information accumulation unit for accumulating the information of channel estimation as the information of channel state for a predetermined interval;

the feedback signal generating means comprises:

a transmission weight generator for generating K*N transmission weights based on the information of channel estimation from the channel state information unit and sending the transmission weights as the feedback information to a transmitter through the feedback path;

the feedback-delay compensating means comprises:

a transmission weight accumulation unit for accumulating the transmission weights for a predetermined interval and outputting the accumulated transmission weights as the processed feedback information; and

the proper reception weight generating means comprises:

a receiving weight generating unit for

generating the proper #1 to #L reception weights by using the information of channel state and processed feedback information.

5. A receiver according to claim 2, further comprising:

a received power estimation unit for estimating a condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of the known symbol; and

the receiver, in which

the channel state estimating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting information of channel estimation; and

a channel information accumulation unit for accumulating the information of channel estimation as the information of channel state for a predetermined interval;

the feedback signal generating means comprises:

a transmission weight generator for generating K*N transmission weights based on the information of channel estimation from the channel state information unit and sending the transmission weights as the feedback information to a transmitter through the feedback path;

the feedback-delay compensating means comprises:

a transmission weight accumulation unit for accumulating the transmission weights for a predetermined interval and outputting the accumulated transmission weights as the processed feedback information; and

the proper reception weight generating means

comprises:

a first reception weight generator for generating K*L first reception weights by using the information of channel estimation from the channel state
5   estimation unit and processed feedback information from the transmission weight accumulation unit;

a second reception weight generator for generating K*L second reception weights by using the information of channel state from the channel information
10   accumulation unit and processed feedback information from the transmission weight accumulation unit; and

a weight selector for estimating a transmission quality according to the first reception weights, second reception weights, processed feedback
15   information, information of channel state and condition of received power from the received power estimation unit, and selecting the proper reception weights.

6. A receiver according to claim 2, further comprising:

20   a received power estimation unit for estimating a condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of the known symbol; and

the receiver, in which
25   the channel state estimating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting the information of channel estimation;

30   a channel information accumulation unit for accumulating the information of channel estimation for a

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predetermined interval; and

a channel information selector for selecting channel information to be used as the information of channel state for generating K*L proper reception weights according to the information of channel estimation from the channel state estimation unit, accumulated information of channel estimation in the channel information accumulation unit and condition of received power as well as given information of communication capacity, information of delay time and information of Doppler frequency;

the feedback signal generating means comprises:

a transmission weight generator for generating K*N transmission weights based on the information of channel estimation from the channel state information unit and sending the transmission weights as the feedback information to a transmitter through the feedback path;

the feedback-delay compensating means comprises:

a transmission weight accumulation unit for accumulating the transmission weights for a predetermined interval and outputting the accumulated transmission weights as the processed feedback information; and

the proper reception weight generating means comprises:

a reception weight generator for generating K*L reception weights by using the selected channel information from the channel information selector and processed feedback information from the transmission weight accumulation unit.

7. A receiver according to claim 2, in which the channel state estimating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting information of channel estimation;

5   a channel information storage for storing past information of channel estimation which has been outputted from the channel state estimation unit;

a channel information adjusting unit for adjusting the information of channel estimation according to given information of time delay and the past
10   information of channel estimation stored in the channel information storage and outputting adjusted information of channel estimation; and

a channel information accumulation unit for
15   accumulating the adjusted information of channel estimation as the information of channel state for a predetermined interval;

the feedback signal generating means comprises:

a transmission weight generator for generating
20   K*N transmission weights based on the adjusted information of channel estimation from the channel information adjusting unit and sending the transmission weights as the feedback information to a transmitter through the feedback path; and

25   the feedback-delay compensating means comprises:

a transmission weight accumulation unit for accumulating the transmission weights as the processed feedback information for a predetermined interval.

8. A receiver according to claim 2, further
30   comprising:

a received power estimation unit for estimating a

condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of the known symbol; and

the receiver, in which

5   the channel state estimating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting information of channel estimation;

10   a channel information storage for storing past information of channel estimation which has been outputted from the channel state estimation unit;

a channel information adjusting unit for adjusting the information of channel estimation according

15   to given information of time delay and the past information of channel estimation stored in the channel information storage and outputting adjusted information of channel estimation; and

a channel information accumulation unit for

20   accumulating the adjusted information of channel estimation as the information of channel state for a predetermined interval;

the feedback information generating means comprises:

a transmission weight generator for generating

25   K*N transmission weights based on the adjusted information of channel estimation from the channel information adjusting unit and sending the transmission weights as the feedback information to a transmitter through the feedback path;

30   the feedback-delay compensating means comprises:

a transmission weight accumulation unit for

accumulating the transmission weights as the processed feedback information for a predetermined interval; and

the proper reception weight generating means comprises:

5   a first reception weight generator for generating K*L first reception weights by using the adjusted information of channel estimation from the channel information adjusting unit and processed feedback information from the transmission weight accumulation

10   unit;

a second reception weight generator for generating K*L second reception weights by using the information of channel state from the channel information accumulation unit and processed feedback information from

15   the transmission weight accumulation unit; and

a weight selector for estimating a transmission quality according to the first reception weights, second reception weights, processed feedback information, adjusted information of channel estimation

20   and condition of received power, and selecting reception weights to be used as the proper reception weights.

9. A receiver according to claim 2, further comprising:

a received power estimation unit for estimating a

25   condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of the known symbol; and

the receiver, in which

the channel state estimating means comprises:

30   a channel state estimation unit for estimating state of each communication channel from the received

signals received by the #1 to #L antennas and outputting information of channel estimation;

a channel information storage for storing past information of channel estimation which has been outputted from the channel state estimation unit;

a channel information adjusting unit for adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation stored in the channel information storage and outputting adjusted information of channel estimation;

a channel information accumulation unit for accumulating the adjusted information of channel estimation for a predetermined interval; and

a channel information selector for selecting channel information as the information of channel state to be used for generation of the proper reception weights according to the adjusted information of channel estimation, adjusted and accumulated information of channel estimation in the channel information accumulation unit and condition of received power as well as given information of communication capacity, information of delay time and information of Doppler frequency;

the feedback information generating means comprises:

a transmission weight generator for generating K*N transmission weights based on the adjusted information of channel estimation from the channel information adjusting unit and sending the transmission weights as the feedback information to a transmitter through the feedback path;

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the feedback-delay compensating means comprises:

a transmission weight accumulation unit for accumulating the transmission weights as the processed feedback information for a predetermined interval; and

5   the proper reception weight generating means comprises:

a reception weight generator for generating K*L reception weights by using the information of channel state from the channel information selector and processed

10   feedback information from the transmission weight accumulation unit.

10. A receiver according to claim 2, in which

the channel information estimating means comprises:

a channel state estimation unit for estimating

15   state of each communication channel from received signals received by the #1 to #L antennas to obtain information of channel estimation as the information of channel state;

the feedback information generating means comprises:

20   a transmission weight generator for generating K*N transmission weights according to the information of channel estimation; and

a transmission weight quantization unit for quantizing the transmission weights and sending the

25   quantized transmission weights as the feedback information to a transmitter through the feedback path; and

the feedback-delay compensating means comprises:

a transmission weight accumulation unit for

30   accumulating the quantized transmission weights as the processed feedback information for a predetermined

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interval.

11. A receiver according to claim 2, in which the channel state estimating means comprises:

a channel state estimation unit for estimating state of each communication channel from received signals received by the #1 to #L antennas to obtain information of channel estimation as the information of channel state;

the feedback information generating means comprises:

a transmission weight generator for generating K*N transmission weights according to the information of channel state;

a transmission weight storage for storing past transmission weights which have been generated by the transmission weight generator; and

a transmission weight adjusting unit for adjusting the transmission weights from the transmission weight generator according to the past transmission weights stored in the transmission weight storage and given information of time delay and sending the adjusted transmission weights as the feedback information to a transmitter through the feedback path; and

the feedback-delay compensating means comprises:

a transmission weight accumulation unit for accumulating the adjusted transmission weights for a predetermined interval as the processed feedback information.

12. An MIMO communication system comprising a transmitter with #1 to #N (N is an integer equal to or greater than 2) antennas and a receiver with #1 to #L (L is an integer equal to or greater than 2) antennas, in

which

said transmitter comprises:

a transmission signal generator for generating a transmission signal;

5   a sender-side transmission weight generator for generating K*N sender-side transmission weights based on feedback information from the receiver through a feedback path;

a signal dividing unit for dividing the

10   transmission signal into #1 to #K (K is an integer equal to or less than smaller one of N or L) signal streams according to the sender-side transmission weights;

a signal modulator for modulating the #1 to #K signal streams, respectively; and

15   a stream processor for dividing respective #1 to #K modulated signal streams into #1 to #N substreams and multiplying the #1 to #N substreams by the sender-side #1 to #N transmission weights, respectively; and

said receiver comprising:

20   a feedback information generating means for generating primitive feedback information from received #1 to #L substreams received by the #1 to #L antennas of the receiver;

a feedback-delay processing means for

25   adjusting the primitive feedback information to obtain feedback information and sending the feedback information to the transmitter through the feedback path;

a feedback-delay compensating means for compensating a feedback-delay for the feedback

30   information from the feedback-delay processing means;

a proper reception weight generating means for

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generating K*L proper reception weights by using the compensated feedback information from the feedback-delay compensating means;

a reception weight multiplier for multiplying the received #1 to #L substreams of respective #1 to #K signal streams by the proper #1 to #L reception weights, respectively;

a demodulator for composing the #1 to #L weighted substreams to obtain respective composed #1 to #K signal streams and demodulating the composed #1 to #K signal streams, respectively; and

a signal combining unit corresponding to the signal dividing unit of the transmitter for combining the demodulated K signal streams from the demodulator to reproduce the original transmission signal.

13. A receiver with #1 to #L (L is an integer equal to or greater than 2) antennas in an MIMO communication system comprising:

a feedback information generating means for generating primitive feedback information from received #1 to #L substreams received by the #1 to #L antennas of the receiver;

a feedback-delay processing means for adjusting the primitive feedback information to obtain feedback information and sending the feedback information to a transmitter through a feedback path;

a feedback-delay compensating means for compensating a feedback-delay for the feedback information from the feedback-delay processing means;

a proper reception weight generating means for generating K*L proper reception weights by using the

feedback-delay compensated feedback information from the feedback-delay compensating means;

a reception weight multiplier for multiplying the received #1 to #L substreams of respective #1 to #K signal streams by the proper #1 to #L reception weights, respectively;

a demodulator for composing the #1 to #L weighted substreams to obtain respective composed #1 to #K signal streams and demodulating the composed #1 to #K signal streams, respectively; and

a signal combining unit for combining the demodulated K signal streams from the demodulator to reproduce an original transmission signal.

14. A receiver according to claim 13, in which

the feedback information generating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the primitive feedback information; whereby the channel state estimating unit also works as the feedback-delay processing means for sending the primitive feedback information as the feedback information to the transmitter through the feedback path and to the feedback-delay compensating means;

the feedback-delay compensating means comprises:

a channel information accumulation unit for accumulating the feedback information from the channel state estimation unit; and

a receiver-side transmission weight generator for generating K*N receiver-side transmission weights as

the feedback-delay compensated feedback information based on the accumulated feedback information from the channel information accumulation unit; and

the proper reception weight generating means comprises:

a reception weight generator for generating K*L proper reception weights by using the accumulated feedback information from the channel information accumulation unit and the feedback-delay compensated feedback information from the transmission weight generator.

15. A receiver according to claim 13, further comprising:

a received power estimation unit for estimating a condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of the known symbol; and

the receiver in which

the feedback information generating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain the information of channel estimation as the primitive feedback information; whereby the channel state estimating unit also works as the feedback-delay processing means for sending the primitive feedback information as the feedback information to the transmitter through the feedback path and to the feedback-delay compensating means;

the feedback-delay compensating means comprises:

a channel information accumulation unit for

accumulating the primitive feedback information from the channel state estimation unit; and

a receiver-side transmission weight generator for generating K*N receiver-side transmission weights as the feedback-delay compensated feedback information based on the accumulated feedback information from the channel information accumulation unit; and

the proper reception weight generating means comprises:

a first reception weight generator for generating K*L first reception weights by using the information of channel estimation from the channel state estimation unit and the feedback-delay compensated feedback information from the transmission weight generator;

a second reception weight generator for generating K*L second reception weights by using the accumulated feedback information from the channel information accumulation unit and the receiver-side transmission weights from the transmission weight generator; and

a weight selector for estimating a transmission quality according to the first reception weights, second reception weights, receiver-side transmission weights, information of channel estimation and condition of received power, and selecting the proper reception weights from the first or second reception weights.

16. A receiver according to claim 13, further comprising:

a received power estimation unit for estimating a

condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of the known symbol; and

the receiver, in which

5   the feedback information generating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain the information of channel estimation as the primitive

10   feedback information; whereby the channel state estimating unit also works as the feedback-delay processing means for sending the primitive feedback information as the feedback information to the transmitter through the feedback path and to the

15   feedback-delay compensating means;

the feedback-delay compensating means comprises:

a channel information accumulation unit for accumulating the primitive feedback information from the channel state estimation unit; and

20   a receiver-side transmission weight generator for generating K*N receiver-side transmission weights as the feedback-delay compensated feedback information based on the accumulated feedback information from the channel information accumulation unit; and

25   the proper reception weight generating means comprises:

a channel information selector for selecting channel information to be used for generation of K*L proper reception weights according to the information of

30   channel estimation, accumulated information of channel estimation in the channel information accumulation unit

and condition of received power as well as given information of communication capacity, information of delay time and information of Doppler frequency; and

a reception weight generator for generating K*L proper reception weights by using the selected channel information from the channel information selector and the feedback-delay compensated feedback information from the receiver-side transmission weight accumulation unit.

17. A receiver according to claim 13, in which the feedback information generating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting information of channel estimation as the primitive feedback information;

the feedback information processing means comprises:

a channel information storage for storing past information of channel estimation which has been outputted from the channel state estimation unit;

a channel information adjusting unit for adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation stored in the channel information storage and sending the adjusted information of channel estimation as the feedback information to a transmitter through a feedback path and to the feedback-delay compensating means; and

the feedback-delay compensating means comprises:

a channel information accumulation unit for accumulating the adjusted information of channel

estimation from the channel information adjusting unit for a predetermined interval;

a receiver-side transmission weight generator for generating K*N receiver-side transmission weights based on the adjusted and accumulated information of channel estimation in the channel information accumulation unit;

a transmission weight accumulation unit for accumulating the receiver-side transmission weights from the receiver-side transmission weight generator for a predetermined interval and outputting the receiver-side transmission weights as the feedback-delay compensated feedback information to the proper reception weight generating means; and

the proper reception weight generating means comprises:

a reception weight generator for generating the proper #1 to #L reception weights by using the accumulated feedback information from the channel information accumulation unit and the feedback-delay compensated feedback information from the transmission weight generator.

18. A receiver according to claim 13, further comprising:

a received power estimation unit for estimating a condition of received power by using information of channel estimation, received signals received by the #1 to #L antennas and information of the known symbol; and

the receiver, in which

the feedback information generating means comprises:

a channel state estimation unit for estimating

state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the primitive feedback information;

5   the feedback information processing means comprises:

a channel information storage for storing past information of channel estimation which has been outputted from the channel state estimation unit;

a channel information adjusting unit for

10 adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation stored in the channel information storage and sending the adjusted information of channel estimation as the feedback information to the

15 transmitter through the feedback path;

the feedback-delay compensating means comprises:

a channel information accumulation unit for accumulating the adjusted information of channel estimation from the channel information adjusting unit

20 for a predetermined interval;

a receiver-side transmission weight generator for generating K*N receiver-side transmission weights based on the adjusted and accumulated information of channel estimation in the channel information

25 accumulation unit; and

a transmission weight accumulation unit for accumulating the receiver-side transmission weights from the receiver-side transmission weight generator for a predetermined interval as the feedback-delay compensated

30 feedback information; and

the proper reception weight generating means

comprises:

a first reception weight generator for generating K*L first reception weights by using the adjusted information of channel estimation from the channel state estimation unit and the feedback-delay compensated feedback information from the transmission weight accumulation unit;

a second reception weight generator for generating K*L second reception weights by using the adjusted and accumulated information of channel estimation in the channel information accumulation unit and the feedback-delay compensated feedback information from the transmission weight accumulation unit; and

a weight selector for estimating a transmission quality according to the first reception weights, second reception weights, feedback-delay compensated feedback information, adjusted information of channel estimation from the channel information adjusting unit and condition of received power, and selecting the proper reception weights.

19. A receiver according to claim 13, further comprising:

a received power estimation unit for estimating a condition of received power by using information of channel estimation, received signals received by the #1 to #L antennas and information of the known symbol; and

the receiver, in which

the feedback information generating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain

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information of channel estimation as the primitive feedback information;

the feedback information processing means comprises:

a channel information storage for storing past information of channel estimation which has been outputted from the channel state estimation unit;

a channel information adjusting unit for adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation stored in the channel information storage and sending the adjusted information of channel estimation as the feedback information to the transmitter through the feedback path;

the feedback-delay compensating means comprises:

a channel information accumulation unit for accumulating the adjusted information of channel estimation from the channel information adjusting unit for a predetermined interval;

a receiver-side transmission weight generator for generating K*N receiver-side transmission weights based on the adjusted and accumulated information of channel estimation in the channel information accumulation unit; and

a transmission weight accumulation unit for accumulating the receiver-side transmission weights from the receiver-side transmission weight generator for a predetermined interval as the feedback-delay compensated feedback information; and

the proper reception weight generating means comprises:

a channel information selector for selecting

channel information to be used for generation of K*L proper reception weights according to the adjusted information of channel estimation, adjusted and accumulated information of channel estimation in the channel information accumulation unit and condition of received power as well as given information of communication capacity, information of delay time and information of Doppler frequency; and

a reception weight generator for generating K*L proper reception weights by using the selected channel information from the channel information selector and the feedback-delay compensated feedback information from the receiver-side transmission weight accumulation unit.

20. A receiver according to claim 13, in which the feedback information generating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the primitive feedback information;

the feedback information processing means comprises:

a channel information storage for storing past information of channel estimation which has been generated by the channel state estimation unit; and

a channel information adjusting unit for adjusting the information of channel estimation according to the past information of channel estimation stored in the channel information storage and given information of time delay and sending the adjusted channel information as the feedback information to the transmitter through

the feedback path;

the feedback-delay compensating means comprises:

a channel information accumulation unit for accumulating the adjusted channel information from the channel information adjusting unit for a predetermined interval; and

a receiver-side transmission weight generator for generating K*N receiver-side transmission weights as the feedback-delay compensated feedback information by using the adjusted and accumulated channel information in the channel information accumulation unit; and

the proper reception weight generating means comprises:

a reception weight generator for generating K*L proper reception weights by using the information of channel estimation from the channel state estimation unit and the feedback-delay compensated feedback information.

21. A receiver according to claim 13, in which

the feedback information generating means comprises:

a channel state estimation unit for estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the primitive feedback information;

the feedback information processing means comprises:

a channel quantization unit for quantizing the information of channel estimation and sending the quantized channel information as the feedback information to the transmitter through the feedback path;

the feedback-delay compensating means comprises:

a channel information accumulation unit for

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accumulating the quantized channel information for a predetermined interval; and

a receiver-side transmission weight generator for generating K*N receiver-side transmission weights as the feedback-delay compensated feedback information according to the accumulated quantized channel information from the channel information accumulation unit; and

the proper reception weight generating means comprises:

a reception weight generator for generating K*L proper reception weights by using the information of channel estimation from the channel state estimation unit and the feedback-delay compensated feedback information from the receiver-side transmission weight generator.

22. A receiver with #1 to #L (L is an integer equal to or greater than 2) antennas in an MIMO communication system comprising:

a channel state estimation unit for estimating state of each communication channel from received signals received by the #1 to #L antennas to obtain information of channel estimation;

a feedback information generator for generating feedback information according to the information of channel estimation from the channel state estimation unit;

a feedback information processing unit for processing the feedback information according to a condition of the feedback path and generating the processed feedback information to be sent to a transmitter through a feedback path;

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a feedback information accumulation unit for accumulating the feedback information for a predetermined interval;

a reception weight generator for generating K*L reception weights by using the information of channel estimation from the channel state estimation unit and accumulated feedback information in the feedback information accumulation unit;

a reception weight multiplier for multiplying the received #1 to #L substreams of respective #1 to #K signal streams by the #1 to #L reception weights, respectively;

a demodulator for composing the #1 to #L weighted substreams to obtain respective composed #1 to #K signal streams and demodulating the composed #1 to #K signal streams, respectively; and

a signal combining unit for combining the demodulated K signal streams from the demodulator to reproduce an original transmission signal.

23. A method of receiving and reproducing MIMO transmission signal comprising the steps of:

(a) step of estimating state of each communication channel from the received signals received by #1 to #L antennas of an MIMO receiver to output information of channel state;

(b) step of generating feedback information according to the information of channel state;

(c) step of sending the feedback information to a transmitter through a feedback path;

(d) step of processing the feedback information in order to compensate feedback-delay of a feedback path;

(e) step of generating K*L proper reception weights by using the information of channel state and processed feedback information;

(f) step of multiplying the received #1 to #L substreams of respective #1 to #K signal streams by the proper #1 to #L reception weights, respectively;

(g) step of composing the #1 to #L weighted substreams to obtain respective composed #1 to #K signal streams;

(h) step of demodulating the composed #1 to #K signal streams, respectively; and

(i) step of combining the demodulated K signal streams to reproduce an original transmission signal.

24. A method of receiving and reproducing MIMO transmission signal according to claim 23, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting information of channel estimation as the information of channel state;

(b) step includes:

(b1) step of generating K*N transmission weights based on the information of channel estimation;

(c) step includes:

(c1) step of sending the transmission weights as the feedback information to the transmitter through the feedback path;

(d) step includes:

(d1) step of accumulating the transmission weights as the processed feedback information for a predetermined interval; and

(e) step includes:

(e1) step of generating K*L proper reception weights by using the information of channel state and processed feedback information.

5　　　25. A method of receiving and reproducing MIMO transmission signal according to claim 23, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received 10　by the #1 to #L antennas and outputting information of channel estimation; and

(a2) step of accumulating the information of channel estimation as the information of channel state for a predetermined interval;

15　　　(b) step includes:

(b1) step of generating K*N transmission weights based on the information of channel estimation;

(c) step includes:

(c1) step of sending the transmission weights 20　as the feedback information to the transmitter through the feedback path;

(d) step includes:

(d1) step of accumulating the transmission weights as the processed feedback information for a 25　predetermined interval; and

(e) step includes:

(e1) step of generating K*L proper #1 to #L reception weights by using the information of channel state and processed feedback information.

30　　　26. A method of receiving and reproducing MIMO transmission signal according to claim 23, further

comprising the step of:

      (j) step of estimating a condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of

5 a known symbol; and

      the method, in which

      (a) step includes:

          (a1) step of estimating state of each communication channel from the received signals received

10 by the #1 to #L antennas to obtain information of channel estimation; and

          (a2) step of accumulating the information of channel estimation as the information of channel state for a predetermined interval;

15   (b) step includes:

          (b1) step of generating K*N transmission weights as the feedback information based on the information of channel estimation;

      (d) step includes:

20   (d1) step of accumulating the transmission weights as the processed feedback information for a predetermined interval; and

      (e) step includes:

          (e1) step of generating K*L first reception

25 weights by using the information of channel estimation and processed feedback information;

          (e2) step of generating K*L second reception weights by using the information of channel state and processed feedback information;

30   (e3) step of estimating a transmission quality according to the first reception weights, second

reception weights, processed feedback information, information of channel state and condition of received power; and

(e4) step of selecting the proper reception weights.

27. A method of receiving and reproducing MIMO transmission signal according to claim 23, further comprising the step of:

(j) step of estimating a condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of a known symbol; and

the method, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain the information of channel estimation;

(a2) step of accumulating the information of channel estimation for a predetermined interval to obtain accumulated information of channel estimation; and

(a3) step of selecting channel information to be used as the information of channel state for generation of the proper #1 to #L reception weights according to the information of channel estimation, accumulated information of channel estimation and condition of received power as well as given information of communication capacity, information of delay time and information of Doppler frequency;

(b) step includes:

(b1) step of generating K*N transmission

weights based on the information of channel estimation;

(c) step includes:

(c1) step of sending the transmission weights as the feedback information to the transmitter through the feedback path;

(d) step includes:

(d1) step of accumulating the transmission weights for a predetermined interval to obtain accumulated transmission weights as the processed feedback information; and

(e) step includes:

(e1) step of generating K*L reception weights by using the selected channel information and processed feedback information.

28. A method of receiving and reproducing MIMO transmission signal according to claim 23, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation;

(a2) step of storing past information of channel estimation which has been obtained by (a1) step;

(a3) step of adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation to obtain adjusted information of channel estimation; and

(a4) step of accumulating the adjusted information of channel estimation as the information of channel state for a predetermined interval;

(b) step includes:

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(b1) step of generating K*N transmission weights based on the adjusted information of channel estimation;

(c) step includes:

(c1) step of sending the transmission weights as the feedback information to the transmitter through the feedback path; and

(d) step includes:

(d1) step of accumulating the transmission weights as the processed feedback information for a predetermined interval.

29. A method of receiving and reproducing MIMO transmission signal according to claim 23, further comprising the step of:

(j) step of estimating a condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of a known symbol; and

the method, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain the information of channel estimation;

(a2) step of storing past information of channel estimation which has been obtained by (a1) step;

(a3) step of adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation stored by (a2) step; and

(a4) step of accumulating the adjusted

information of channel estimation as the information of channel state for a predetermined interval;

  (b) step includes:

    (b1) step of generating K*N transmission weights based on the adjusted information of channel estimation;

  (c) step includes:

    (c1) step of sending the transmission weights as the feedback information to the transmitter through the feedback path;

  (d) step includes:

    (d1) step of accumulating the transmission weights as the processed feedback information for a predetermined interval; and

  (e) step includes:

    (e1) step of generating K*L first reception weights by using the adjusted information of channel estimation and processed feedback information;

    (e2) step of generating K*L second reception weights by using the information of channel state and processed feedback information;

    (e3) step of estimating a transmission quality according to the first reception weights, second reception weights, processed feedback information, adjusted information of channel estimation and condition of received power; and

    (e4) step of selecting reception weights to be used as the proper reception weights.

  30. A method of receiving and reproducing MIMO transmission signal according to claim 23, further comprising the step of:

(j) step of estimating a condition of received power by using information of channel estimation, received signals received by #1 to #L antennas and information of a known symbol; and

5   the method, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain the information of

10   channel estimation;

(a2) step of storing past information of channel estimation which has been obtained by (a1) step;

(a3) step of adjusting the information of channel estimation according to given information of time

15   delay and the past information of channel estimation stored by (a2) step to obtain adjusted information of channel estimation;

(a4) step of accumulating the adjusted information of channel estimation for a predetermined

20   interval; and

(a5) step of selecting channel information as the information of channel state to be used for generation of the proper #1 to #L reception weights according to the adjusted information of channel

25   estimation, adjusted and accumulated information of channel estimation and condition of received power as well as given information of communication capacity, information of delay time and information of Doppler frequency;

30   (b) step includes:

(b1) step of generating K*N transmission

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weights based on the adjusted information of channel estimation;

    (c) step includes:

        (c1) step of sending the transmission weights as the feedback information to the transmitter through the feedback path; and

    (d) step includes:

        (d1) step of accumulating the transmission weights as the processed feedback information for a predetermined interval.

    31. A method of receiving and reproducing MIMO transmission signal according to claim 23, in which

    (a) step includes:

        (a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the information of channel state;

    (b) step includes:

        (b1) step of generating K*N transmission weights according to the information of channel estimation; and

        (b2) step of quantizing the transmission weights;

    (c) step includes:

        (c1) step of sending the quantized transmission weights as the feedback information to the transmitter through the feedback path; and

    (d) step includes:

        (d1) step of accumulating the quantized transmission weights as the processed feedback information for a predetermined interval.

32. A method of receiving and reproducing MIMO transmission signal according to claim 23, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the information of channel state;

(b) step includes:

(b1) step of generating K*N transmission weights according to the information of channel state;

(b2) step of storing past transmission weights which have been generated by (b1) step; and

(b3) step of adjusting the transmission weights according to the past transmission weights stored by (b2) step and given information of time delay;

(c) step includes:

(c1) step of sending the adjusted transmission weights as the feedback information to the transmitter through the feedback path; and

(d) step includes:

(d1) step of accumulating the adjusted transmission weights for a predetermined interval as the processed feedback information.

33. A method of receiving and reproducing MIMO transmission signal comprising the steps of:

(a) step of generating primitive feedback information from received #1 to #L substreams received by #1 to #L antennas of a receiver;

(b) step of adjusting the primitive feedback information to obtain feedback information;

(c) step of sending the feedback information to a

transmitter through a feedback path;

(d) step of compensating feedback-delay for the feedback information;

(e) step of generating K*L proper reception weights by using the feedback-delay compensated feedback information;

(f) step of multiplying the received #1 to #L substreams of respective #1 to #K signal streams by the proper #1 to #L reception weights, respectively;

(g) step of composing the #1 to #L weighted substreams to obtain respective composed #1 to #K signal streams;

(h) step of demodulating the composed #1 to #K signal streams, respectively; and

(i) step of combining the demodulated K signal streams to reproduce an original transmission signal.

34. A method of receiving and reproducing MIMO transmission signal according to claim 33, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the primitive feedback information;

(b) step includes:

(b1) step of making the primitive feedback information itself as the feedback information;

(d) step includes:

(d1) step of accumulating the feedback information for a predetermined interval;

(d2) step of generating K*N receiver-side transmission weights as the feedback-delay compensated

feedback information based on the accumulated feedback information by (d1) step; and

     (e) step includes:

        (e1) step of generating K*L proper reception weights by using the accumulated feedback information and feedback-delay compensated feedback information.

     35. A method of receiving and reproducing MIMO transmission signal according to claim 33, further comprising:

     (j) step of estimating a condition of received power by using information of channel estimation, received signals received by the #1 to #L antennas and information of a known symbol; and

     the method, in which

     (a) step includes:

        (a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain the information of channel estimation as the primitive feedback information;

     (b) step includes:

        (b1) step of making the primitive feedback information itself as the feedback information;

     (d) step includes:

        (d1) step of accumulating the feedback information for a predetermined interval; and

        (d2) step of generating K*N receiver-side transmission weights as the feedback-delay compensated feedback information based on the accumulated feedback information by (d1) step; and

     (e) step includes:

        (e1) step of generating K*L first reception

weights by using the information of channel estimation and feedback-delay compensated feedback information;

(e2) step of generating K*L second reception weights by using the accumulated feedback information by (d1) step and receiver-side transmission weights obtained by (e1) step;

(e3) step of estimating a transmission quality according to the first reception weights, second reception weights, receiver-side transmission weights, information of channel estimation and condition of received power; and

(e4) step of selecting the proper reception weights from the first or second reception weights according to the transmission quality.

36. A method of receiving and reproducing MIMO transmission signal according to claim 33, further comprising:

(j) step of estimating a condition of received power by using information of channel estimation, received signals received by the #1 to #L antennas and information of a known symbol; and

the method, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain the information of channel estimation as the primitive feedback information;

(b) step includes:

(b1) step of making the primitive feedback information itself as the feedback information;

(d) step includes:

(d1) step of accumulating the feedback information for a predetermined interval; and

(d2) step of generating K*N receiver-side transmission weights as the feedback-delay compensated feedback information based on the accumulated feedback information; and

(e) step includes:

(e1) step of selecting channel information to be used for generation of K*L proper reception weights according to the primitive feedback information, accumulated feedback information and condition of received power as well as given information of communication capacity, information of delay time and information of Doppler frequency; and

(e2) step of generating K*L proper reception weights by using the selected channel information selected at (e1) step and the feedback-delay compensated feedback information.

37. A method of receiving and reproducing MIMO transmission signal according to claim 33, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas and outputting information of channel estimation as the primitive feedback information;

(b) step includes:

(b1) step of storing past information of channel estimation which has been outputted by (a1) step;

(b2) step of adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation

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stored at (b1) step;

        (c) step includes:

                (c1) step of sending the adjusted information of channel estimation as the feedback information to the transmitter through the feedback path; and

        (d) step includes:

                (d1) step of accumulating the adjusted information of channel estimation for a predetermined interval as accumulated feedback information;

                (d2) step of generating $K*N$ receiver-side transmission weights based on the accumulated feedback information; and

                (d3) step of accumulating the receiver-side transmission weights for a predetermined interval as the feedback-delay compensated feedback information; and

        (e) step includes:

                (e1) step of generating $K*L$ proper reception weights by using the accumulated feedback information and the feedback-delay compensated feedback information.

38. A method of receiving and reproducing MIMO transmission signal according to claim 33, further comprising:

        (j) step of estimating a condition of received power by using information of channel estimation, received signals received by the #1 to #L antennas and information of a known symbol; and

        the method, in which

        (a) step includes:

                (a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain the information of

channel estimation as the primitive feedback information;

(b) step includes:

(b1) step of storing past information of channel estimation which has been obtained by (a1) step; and

(b2) step of adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation stored at (b2) step;

(c) step includes:

(c1) step of sending the adjusted information of channel estimation as the feedback information to the transmitter through the feedback path;

(d) step includes:

(d1) step of accumulating the feedback information for a predetermined interval;

(d2) step of generating K*N receiver-side transmission weights based on the accumulated feedback information; and

(d3) step of accumulating the receiver-side transmission weights for a predetermined interval as the feedback-delay compensated feedback information; and

(e) step includes:

(e1) step of generating K*L first reception weights by using the feedback information and feedback-delay compensated feedback information;

(e2) step of generating K*L second reception weights by using the accumulated feedback information and the feedback-delay compensated feedback information; and

(e3) step of estimating a transmission quality according to the first reception weights, second

reception weights, feedback-delay compensated feedback information, feedback information and condition of received power; and

(e4) step of selecting the proper reception weights from the first or second reception weights according to the transmission quality.

39. A method of receiving and reproducing MIMO transmission signal according to claim 33, further comprising:

(j) step of estimating a condition of received power by using information of channel estimation, received signals received by the #1 to #L antennas and information of a known symbol; and

the method, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the primitive feedback information;

(b) step includes:

(b1) step of storing past information of channel estimation which has been outputted at (a1) step;

(b2) step of adjusting the information of channel estimation according to given information of time delay and the past information of channel estimation stored by (b1) step;

(c) step includes:

(c1) step of sending the adjusted information of channel estimation as the feedback information to the transmitter through the feedback path;

(d) step includes:

(d1) step of accumulating the feedback information for a predetermined interval;

(d2) step of generating K*N receiver-side transmission weights based on the accumulated feedback information; and

(d3) step of accumulating the receiver-side transmission weights for a predetermined interval as the feedback-delay compensated feedback information; and

(e) step includes:

(e1) step of selecting channel information to be used for generation of K*L proper reception weights according to the feedback information, accumulated feedback information and condition of received power as well as given information of communication capacity, information of delay time and information of Doppler frequency; and

(e2) step of generating K*L proper reception weights by using the selected channel information and the feedback-delay compensated feedback information.

40. A method of receiving and reproducing MIMO transmission signal according to claim 33, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the primitive feedback information;

(b) step includes:

(b1) step of storing past information of channel estimation which has been generated at (a1) step; and

(b2) step of adjusting the information of

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channel estimation according to the past information of channel estimation stored at (b1) step and given information of time delay;

(c) step includes:

(c1) step of sending the adjusted channel information as the feedback information to the transmitter through the feedback path;

(d) step includes:

(d1) step of accumulating the feedback information for a predetermined interval; and

(d2) step of generating K*N receiver-side transmission weights as the feedback-delay compensated feedback information by using the accumulated feedback information; and

(e) step includes:

(e1) step of generating K*L proper reception weights by using the primitive feedback information and the feedback-delay compensated feedback information.

41. A method of receiving and reproducing MIMO transmission signal according to claim 33, in which

(a) step includes:

(a1) step of estimating state of each communication channel from the received signals received by the #1 to #L antennas to obtain information of channel estimation as the primitive feedback information;

(b) step includes:

(b1) step of quantizing the information of channel estimation;

(c) step includes:

(c1) step of sending the quantized channel information as the feedback information to the

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transmitter through the feedback path;

(d) step includes:

(d1) step of accumulating the quantized channel information for a predetermined interval; and

5 (d2) step of generating K*N receiver-side transmission weights as the feedback-delay compensated feedback information by using the accumulated quantized channel information; and

(e) step includes:

10 (e1) step of generating K*L proper reception weights by using the primitive feedback information and the feedback-delay compensated feedback information.

42. A method of receiving and reproducing MIMO transmission signal comprising the steps of:

15 (a) step of estimating state of each communication channel from received signals received by #1 to #L antennas of an MIMO receiver to obtain information of channel estimation;

(b) step of generating primitive feedback
20 information according to the information of channel estimation;

(c) step of processing the primitive feedback information according to a condition of a feedback path to obtain feedback information to be sent to a
25 transmitter through the feedback path;

(d) step of accumulating the primitive feedback information for a predetermined interval as feedback-delay compensated feedback information;

(e) step of generating K*L reception weights by
30 using the information of channel estimation and feedback-delay compensated feedback information;

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(f) step of multiplying the received #1 to #L substreams of respective #1 to #K signal streams by the #1 to #L reception weights, respectively;

(g) step of composing the #1 to #L weighted substreams to obtain respective composed #1 to #K signal streams;

(h) step of demodulating the composed #1 to #K signal streams, respectively; and

(i) step of combining the demodulated K signal streams to reproduce an original transmission signal.